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CLAIMS

What is claimed:

[c01] An organic-based aluminizing composition, comprising an aluminum-based powder and at least one organic resin.

[c02] The composition of claim 1, wherein the organic resin is selected from the group consisting of epoxy resins, silicone resins, alkyd resins, acrylic resins, polyurethane resins, polyvinyl chloride resins, phenolic resins, polyester resins, urethane resins, polyamide resins, polyolefin resins, and combinations of any of the foregoing.

[c03] The composition of claim 1, wherein the aluminum powder comprises substantially spherical powder particles.

[c04] The composition of claim 3, wherein the substantially spherical powder particles have an average particle size in the range of about 0.5 micron to about 200 microns.

[c05] The composition of claim 4, wherein the powder particles have an average particle size in the range of about 1 micron to about 50 microns.

[c06] The composition of claim 1, further comprising at least one organic solvent.

[c07] The composition of claim 6, wherein the organic solvent is selected from the group consisting of alcohols, glycols, ketones, aldehydes, aromatic compounds, dimethylformamide, mineral spirits; naphtha, nitrated hydrocarbons, chlorinated hydrocarbons, and mixtures of any of the foregoing.

[c08] The composition of claim 2, wherein the epoxy resin comprises bisphenol A.

[c09] The composition of claim 2, wherein the silicone resin comprises a modified or unmodified silicone varnish.

[c10] The composition of claim 2, wherein the silicone resin comprises at least one organopolysiloxane.

[c11] The composition of claim 2, wherein the silicone resin comprises a silicone alkyd, a silicone epoxy, or a silicone polyester.

[c12] The composition of claim 2, wherein the alkyd resin comprises the reaction product of phthalic anhydride and glycerol.

[c13] The composition of claim 1, wherein the amount of aluminum exceeds the amount of aluminum present in the substrate by up to about 65 atomic %.

[c14] The composition of claim 1, wherein the aluminum-based powder comprises an alloy of aluminum and silicon.

[c15] The composition of claim 1, wherein the aluminum-based powder further comprises at least one metal selected from the group consisting of platinum group metals, rare earth metals, scandium, yttrium, iron, chromium, and cobalt.

[c16] The composition of claim 1, substantially free of hexavalent chromium.

[c17] The composition of claim 1, containing less than about 10% by weight of phosphoric acid and phosphoric acid derivatives, based on the weight of the entire composition.

[c18] The composition of claim 1, further comprising aluminum flakes.

[c19] The composition of claim 1, further comprising at least one material selected from the group consisting of pigments, diluents, curing agents, deflocculants, dispersants, anti-settling agents, surfactants, anti-foam agents, driers, extenders, and lubricants.

[c20] An organic-based aluminizing composition for providing aluminum to the surface region of a turbine component formed from a material comprising a nickel-based superalloy, where the composition is substantially free of hexavalent chromium, and comprises an aluminum-based powder and at least one organic resin component selected from the group consisting of epoxy resins, silicone resins, alkyd resins, acrylic resins, polyurethane resins, polyvinyl chloride resins, phenolic resins, polyester resins, urethane resins, polyamide resins, polyolefin resins, and combinations of any of the foregoing.

[c21] The aluminizing composition of claim 20, wherein the aluminum powder comprises substantially spherical powder particles having an average particle size in the range of about 1 micron to about 50 microns; and wherein the amount of aluminum in the composition exceeds the amount of aluminum present in the surface region of the turbine component by up to about 65 atomic %.

[c22] A method for aluminiding the surface region of a metal substrate, comprising the following steps:

(I) applying at least one layer of an organic-based aluminizing composition to the surface of the substrate; wherein the composition is substantially free of hexavalent chromium, and comprises an aluminum-based powder and at least one organic resin; and then

(II) heat treating the aluminizing composition, under conditions sufficient to cause diffusion of aluminum into the surface region of the substrate.

[c23] The method of claim 22, wherein the organic resin is selected from the group consisting of epoxy resins, silicone resins, alkyd resins, acrylic resins, polyurethane resins, polyvinyl chloride resins, phenolic resins, polyester resins, urethane resins, polyamide resins, polyolefin resins, and combinations of any of the foregoing.

[c24] The method of claim 22, wherein the aluminum powder comprises substantially spherical powder particles.

[c25] The method of claim 24, wherein the substantially spherical powder particles have an average particle size in the range of about 0.5 micron to about 200 microns.

[c26] The method of claim 22, wherein the aluminum-based powder in the composition comprises an alloy of aluminum and silicon.

[c27] The method of claim 22, wherein the aluminum-based powder further comprises at least one metal selected from the group consisting of platinum group metals, rare earth metals, scandium, yttrium, iron, chromium, and cobalt.

[c28] The method of claim 22, wherein the aluminizing composition is applied to the surface of the substrate by a technique selected from the group consisting of spraying, slip-casting, brush-painting, dipping, pouring, rolling, or spin-coating.

[c29] The method of claim 22, wherein the heat treatment of step (II) comprises a preliminary heat treatment to remove at least some of the

volatile components, and a final heat treatment to diffuse the aluminum into the substrate.

[c30] The method of claim 22, wherein the heat treatment is carried out at a temperature in the range of about 650°C to about 1100°C.

[c31] The method of claim 22, wherein step (II) comprises a graduated heat treatment.

[c32] A method for aluminiding the surface region of a turbine component formed from a material comprising a nickel-based superalloy, comprising the following steps:

(i) spraying at least one layer of an organic-based aluminizing composition to the surface of the substrate; wherein the composition is substantially free of hexavalent chromium, and comprises an aluminum-based powder and at least one organic resin selected from the group consisting of epoxy resins, silicone resins, alkyd resins, acrylic resins, polyurethane resins, polyvinyl chloride resins, phenolic resins, polyester resins, urethane resins, polyamide resins, polyolefin resins, and combinations of any of the foregoing;

(ii) heating the aluminizing composition in a preliminary heat treatment, to remove at least some volatile components contained therein; and

(iii) heat treating the aluminizing composition at a temperature in the range of about 650°C to about 1100°C, to diffuse aluminum into the surface region of the turbine component.

[c33] A method for preparing an organic-based aluminizing composition, comprising the step of adding an aluminum-based powder to an organic coating composition, so that the total amount of aluminum in the

organic coating composition is in the range of about 30% by weight to about 40% by weight.

[c34] The method of claim 33, wherein the aluminum-based powder which is added to the organic coating composition comprises substantially spherical powder particles having an average particle size in the range of about 1 micron to about 50 microns.

[c35] The method of claim 33, wherein the organic coating composition is a commercial paint.

[c36] The method of claim 35, wherein the commercial paint contains aluminum flakes, prior to addition of the aluminum-based powder.

[c37] A metal substrate, having an organic-based aluminizing composition disposed on its surface, said composition being free of hexavalent chromium, and comprising an aluminum-based powder and at least one organic resin.

[c38] The metal substrate of claim 37, wherein the organic resin is selected from the group consisting of epoxy resins, silicone resins, alkyd resins, acrylic resins, polyurethane resins, polyvinyl chloride resins, phenolic resins, polyester resins, urethane resins, polyamide resins, polyolefin resins, and combinations of any of the foregoing.

[c39] The metal substrate of claim 37, in the form of a turbine engine component which comprises a nickel-based superalloy.